

10-18-04

AF/1756 JFW

Attorney's Docket No. 67,200-477

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Chen et al

Group Art Unit: 1756

Serial No.: 09/ 941,537

Examiner: J.S. Ruggles

Filed: Aug. 29, 2001

For: Method for Reducing Light Reflectance in a Photolithographic Dual Damascene Trench Patterning Process

Commissioner for Patents
Alexandria, VA 22313

TRANSMITTAL OF APPEAL BRIEF (PATENT APPLICATION-37 CFR 192)

1. Transmitted herewith, in triplicate, is the **REVISED** APPEAL BRIEF in this application, with respect to the Notice of Non-Compliance dated Sept. 20, 2004.

NOTE: "The Appellant shall, within 2 months from the date of the notice of appeal under §1.191(a) or within the time allowed for response to the action appealed from, if such time is later, file a brief in "triplicate", 37 C.F.R. 1.192(a) [emphasis added].

2. STATUS OF APPLICANT

This application is on behalf of:

X other than a small entity.
___ a small entity.

A verified statement:

___ is attached.
___ was already filed.

3. FEE FOR FILING **REVISED** APPEAL BRIEF

Pursuant to 37 CFR 1.17(f), the fee for filing the Appeal Brief is:

___ small entity \$170.00
___ other than a small entity \$340.00
X was already paid

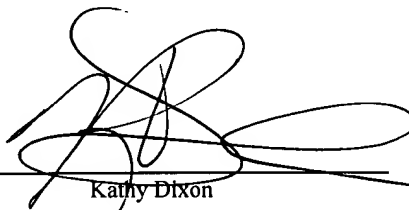
Appeal Brief fee due: \$ 0

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for Patents, Alexandria, VA 22313


Kathy Dixon

Dated: Oct. 15, 2004

4. EXTENSION OF TERM

NOTE: The time periods set forth in 37 CFR 1.192(a) are subject to the provision of ☐ 1.136 for patent applications. 37 CFR 1.191(d). See also Notice of November 5, 1985 (1060 O.G. 27).

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136 apply:

(complete (a) or (b), as applicable)

- (a) ☐ Applicant petitions for an extension of time under 37 CFR 1.136
(fees: 37 CFR 1.17(a)-(d) for the total number of months checked below:

	Extension (months)	Fee for other than small entity	Fee for small entity
<input type="checkbox"/>	one month	\$ 110.00	\$ 55.00
<input type="checkbox"/>	two months	\$ 430.00	\$215.00
<input type="checkbox"/>	three months	\$ 980.00	\$490.00
<input type="checkbox"/>	four months	\$1,530.00	\$765.00

Fee: \$ _____

If an additional extension of time is required, please consider this a petition therefor.

(check and complete the next item, if applicable)

- ☐ An extension for _____ months has already been secured, and the fee paid therefor of \$ _____ is deducted from the total fee due for the total months of extension now requested.

Extension fee due with this request: \$ _____

or

- (b) ☐ Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

5. TOTAL FEE DUE

The total fee due is:

Appeal Brief Fee: \$ 340.00
Extension fee (if any) \$ _____
X was already paid

TOTAL FEE DUE: \$ 0

6. FEE PAYMENT

_____ Attached is a Credit Card Payment Form for the sum of \$ 0
A duplicate copy of this transmittal is attached.

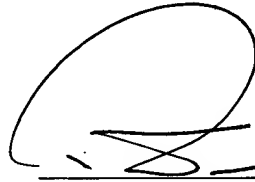
7. FEE DEFICIENCY

NOTE: If there is a fee deficiency and there is no authorization to charge an account, additional fees are necessary to cover the additional time consumed in making up the original deficiency. If the maximum six-month period has expired before the deficiency is noted and corrected, the application is held abandoned. In those instances where authorization to charge is included, processing delays are encountered in returning the papers to the PTO Finance Branch in order to apply these charges prior to action on the cases. Authorization to charge the deposit account for any fee deficiency should be checked. See the Notice of April 7, 1986, 1065 O.G. 31-33.

 X If any additional extension and/or fee is required, this is a request therefor
to charge Visa Credit Card No. 4756 8461 9568 0263

And/Or

 X If any additional fee for claims is required, please charge Visa Credit Card
No. 4756 8461 9568 0263

A handwritten signature in black ink, consisting of a large, stylized 'R' followed by a horizontal line and a small flourish.

Signature of Attorney

Registration No. 31,311

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U.S.S.N. 09/941,537

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant: Chen et al.

Group Art Unit: 1756

Serial No.: 09/941,537

Examiner: J. S. Ruggles

Filed: 08/29/2001

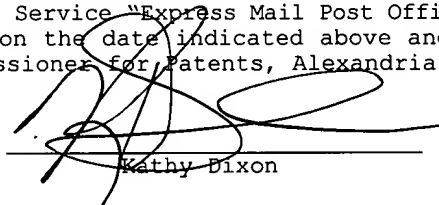
For: METHOD FOR REDUCING LIGHT REFLECTANCE IN A PHOTOLITHOGRAPHIC
DUAL DAMASCENE TRENCH PATTERNING PROCESS

Attorney Docket No.: 67,200-477

EXPRESS MAIL CERTIFICATE

"Express Mail" label number EV 435 808 553 US
Date of Deposit Oct. 15, 2004

I hereby certify that this paper in triplicate are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR \$1.10 on the date indicated above and is addressed to: Mail Stop: Appeal, Commissioner for Patents, Alexandria, VA 22313-1450.


Kathy Dixon

4th Revised APPEAL BRIEF

Box Appeal
Commissioner for Patents
Alexandria, Va 22313-1450

Sir:

APPELLANTS appeal in the captioned application from the Examiner's final rejection, dated 9/11/2003, of claims 1-3, 7-8, 10-11, 13-15, and 17-24 under 35 USC § 103.

It is urged that Examiners final rejection be reversed and that all the claims currently pending be allowed.

(1) REAL PARTY IN INTEREST

The real party in interest in the present appeal is the recorded Assignee, Taiwan Semiconductor Manufacturing Company, Ltd.

(2) RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences that are known to the Appellant, the Appellant's legal representative, or the assignee.

(3) STATUS OF CLAIMS

Claims 1-3, 7-8, 10-11, 13-15, and 17-24 are pending in the application.

Claims 4-6, 9, 12, 16, and 25-26 have been cancelled.

Claims 1-3, 7-8, 10-11, 13-15, and 17-24 stand rejected.

APPELLANTS appeal from the rejection of claims 1-3, 7-8, 10-11, 13-15, and 17-24.

(4) STATUS OF AMENDMENTS

An Amendment was filed on or about 07/30/03 which was entered.

A Request for Reconsideration from Final Rejection was mailed 9/11/2003 including proposed amendments was filed on or about 11/10/2003.

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An Advisory Action from the Examiner was mailed on 11/28/2003 refusing entry of proposed amendments filed on or about 11/10/2003.

A Notice of Appeal together with a first Supplemental Amendment was filed on or about 12/11/2003 amending the Specification as suggested by Examiner in the Advisory Action and canceling claims 25 and 26 to overcome Examiners objections and rejection of claim 26 under 35 USC Section 112 as well as correcting other defects including grammatical errors.

A second Supplemental Amendment with the Appeal Brief was filed on or about 2/11/2004 attempting to insert the language of claim 15 into the Specification to remove an issue on Appeal.

A Notice of Non-compliance with CFR 1.192 was mailed to APPELLANTS on 4/6/2004 together with an Advisory Action alleging errors in APPELLANTS grouping of claims and in the claims as presented in the Appendix primarily related to typographical errors in claim 11 present in the first supplemental amendment and the fact that the Claims Appendix assumed entry of the proposed amendments submitted in APPELLANTS first and second supplemental amendments. The Advisory action also refused APPELLANTS insertion of the language of claim 15 into the Specification.

A third supplemental amendment was filed on or about 5/06/04 together with a revised Appeal Brief, correcting previously

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presented grammatical errors in claim 11 present in the proposed first supplemental amendment and amending claim 15 in response to Examiners requirement, as well as attempting to revise the Appeal Brief in accordance with Examiners requirements.

A second advisory action refusing entry of the 3d supplemental amendment together with a second Notification of Non-Compliance with CFR 1.192 was mailed to APPELLANTS on 6/25/2004 pointing out errors including the now erroneous listing of claims in the Claims Appendix since the third supplemental amendment was not entered due to a failure to double bracket deletions in the Specification and claim 15.

A fourth supplemental amendment was filed together with a 3d revised Appeal brief was filed on or about 7/21/04 addressing the failure to include double bracketing in proposed amendments made in the Specification and claim 15. This Amendment has now been entered.

A Notice of Non-compliance with CFR 1.192 was mailed to APPELLANTS on 9/20/2004 together with an Advisory Action alleging newly found errors in APPELLANTS failure to list both the pending and cancelled claims in the status of claims (although CFR 1.192 states pending or cancelled); **a failure to include a statement that the claims do not stand and fall together** (taken out in response to Applicants interpretation of previous CFR 1.192 Notice of Non-

compliance actions); failure to argue rejection of claims 17-24, a failure to list claim 14 in the grouping of claims; and a failure to incorporate changes in the Claims Appendix included in the 4th Supplemental Amendment, which APPELLANTS have now been advised, has been entered.

APPELLANTS have attempted in good faith to respond to all of Examiners requirements included in CFR 1.192 Notice of Non-compliance actions. APPELLANTS believe the current Appeals Brief addresses all of Examiners requirements/objections and introduces no new grounds for objection and complies with CFR 1.192.

(5) SUMMARY OF THE INVENTION

The invention discloses a method for reducing light reflectance from via sidewalls in a photolithographic trench patterning dual damascene process to reduce undercutting of a photoresist layer thereby maintaining design distance between metal lines. (See Field of Invention Specification, paragraph 001; claim 1; Figures 2, items 25 and 26 and Figure 3, items 35 and 36). The method involves the steps of providing an inter-metal dielectric (IMD) layer comprising at least one via opening extending through a thickness thereof; forming an antireflectance coating (ARC) layer over the IMD layer such that the ARC layer is formed over sidewalls of the at least one via opening without filling the at least one via opening; and, depositing a photoresist layer over the IMD layer

and photolithographically patterning a trench opening over the at least one via opening.

(6) ISSUES

1. Is the rejection of claims 1-3, 21, and 23 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

2. Is the rejection of claims 7 and 8 under USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

3. Is the rejection of claim 10 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US

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5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

4. Is the rejection of claims 11, 13, 14, 19, and 22 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

5. Is the rejection of claim 15, 17 and 24 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

6. Is the rejection of claim 18 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al.

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(US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

7. Is the rejection of claim 20 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

(7) GROUPING OF CLAIMS

The claims do not stand and fall together. Applicants have specifically argued the first claim the grouping of claims as listed below.

1. Group I: Claims 1-3, 21, and 23
2. Group II: Claims 7 and 8
3. Group III: Claim 10
4. Group IV: Claims 11, 13, 14, 19, and 22
5. Group V: Claims 15, 17, and 24

6. Group VI: Claim 18

7. Group VII: Claim 20

(8) ARGUMENTS

Issue 1

Is the rejection of claims 1-3, 21, and 23 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

Lin et al. teach a dual damascene process **by filling a via opening** with **protective material** prior to patterning an overlying trench in a dual damascene process (see Abstract). The protective material serves to protect the exposed material at the bottom of the via opening during a subsequent overlying trench etching process (see e.g., col 6, lines 10-14). Lin et al. teach first forming a via opening portion (see e.g., col 4, lines 55-67, col 5, lines 20-25). After removing the via pattern resist layer, Lin et al. teach depositing a protective material disclosed to be a BARC layer e.g., silicon oxynitride or an

organic material **to fill the via opening**, (see e.g., col 5, lines 35-57, Figure 2C). Lin et al. then teach **removing a portion** of the protective material **from the filled via opening** to about a level of an intervening etch stop layer following patterning of the overlying trench. The protective material is first etched back followed by etching of the overlying trench or simultaneously etched back with the trench etching (see col 5, lines 57-65 and col 5, lines 1-14).

None of the references cited including Lin et al., references, alone or in combination, disclose or teach APPELLANTS claim 1:

"forming an antireflectance coating (ARC) layer over the IMD layer such that the ARC layer is formed over sidewalls of the at least one via opening without filling the at least one via opening; and,

depositing a photoresist layer over the IMD layer and photolithographically patterning a trench opening over the at least one via opening."

The method of Lin et al. clearly teaches removing an ARC layer from a portion of the via opening prior to patterning a trench opening.

The method of Lin et al. clearly teach filling the via opening with an ARC material **thereby requiring a subsequent etchback process** to remove the ARC filling prior to trench etching to protect the bottom of the via opening (see col 6, lines 7-14).

Examiner argues "**while not specifying an alternative embodiment requiring non-filling of the ARC layer** in the holes or openings, it is readily apparent that adequate protection could also be obtained by using one or more ARC layers of sufficient thickness without necessarily requiring that the ARC material fill one or more via openings or holes.." . Examiner is impermissibly re-creating APPELLANTS disclosed invention by hindsight reasoning and can point to no suggestion, hint, or desirability in the teachings of Lin et al. of doing what APPELLANTS have accomplished by their claimed invention.

"The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

The combined teachings of Yu et al. and Filipak et al. with Lin et al. do not help Examiner in establishing a *prima facie* case of obviousness with respect APPELLANTS disclosed and claimed invention.

Yu et al. teach a method for etching sub-quarter micron openings in dielectric insulating layers by using a thin layer DUV photoresist (see Abstract). In one embodiment, Yu et al. disclose forming a via opening for filling with a tungsten plug by using a Ti/TiN etching hardmask which also functions as an ARC layer for etching the via opening (col 4, lines 58-62). The via is then etched with the Ti/TiN layer hard mask providing high selectivity for etching the insulating layer (col 6, lines 19-24).

Yu et al. does not disclose or suggest depositing an ARC layer to fill the via opening as taught by Lin et al., nor disclose or suggest forming an ARC layer formed over sidewalls of a via opening without filling the via opening prior to patterning an overlying trench portion in a dual damascene process as claimed by APPELLANTS. The disclosure of Yu et al. of a Ti/TiN hardmask **prior to** forming a via opening does not help Examiner in establishing a *prima facie* case of obviousness with respect to

APPELLANTS disclosed and claimed invention. The combined teachings of Yu et al. and Lin et al. do not teach, disclose or suggest "forming an antireflectance coating (ARC) layer over the IMD layer such that the ARC layer is formed over sidewalls of the at least one via opening without filling the at least one via opening".

Moreover, there is no apparent motivation or suggestion for combining the teachings of Yu et al. with Lin et al. However, even assuming *arguendo* proper combination of Yu et al. and Lin et al., such combination does not produce APPELLANTS claimed invention.

Filipiak et al. generally disclose types of ARC layers such as silicon oxynitride and titanium nitride in the background of the invention (see col 1, lines 10-20) as well as teaching the use of multiple ARC layers including forming inorganic ARC layers, e.g., silicon oxynitride with a continuously graded composition, or including a plurality of discrete portions to form an antireflective layer (see col 2, lines 17-27, col 3, lines 21-30). There is no apparent motivation for combining Filipiak et al. with either Yu et al. or Lin et al. For example,

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Filipiak et al. disclose the use ARC layers **prior to** etching via openings, and further, do not disclose a dual damascene process.

Nevertheless, assuming *arguendo*, a proper motivation for combining the references, such combination does not produce APPELLANTS disclosed and claimed invention. Neither Lin et al., Yu et al., nor Filipiak et al. disclose or suggest forming an ARC layer over sidewalls of a via opening without filling the via opening to reduce light reflection in a subsequent overlying trench patterning process as disclosed and claimed by APPELLANTS.

None of the references cited recognizes or solves the problem in a way that APPELLANTS disclosed and claimed invention accomplishes:

"A method for reducing light reflectance from via sidewalls in a photolithographic trench patterning dual damascene process"

Issue 2

Is the rejection of claims 7 and 8 under USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or

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solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

APPELLANTS reiterate the statements made above with respect to Issue 1.

With respect to claim 7, APPELLANTS do not disclose or claim a Ti/TiN layer but rather disclose a TiN ARC layer as one element of a Markush group for forming an ARC layer according to claim 1. Neither Lin et al., Yu et al., nor Filipiak et al., alone or in combination, discuss, disclose or suggest the desirability of depositing an ARC layer to cover the via opening sidewalls without filling the via opening prior to a trench patterning process overlying the via. The disclosure of Yu et al. in forming a Ti/TiN hardmask layer that also functions as an ARC layer does not help Examiner in making out a *prima facie* case of obviousness.

Examiner argues that the prior art disclosed in Lin et al. as shown in Figures 1C through 1F, support Examiners argument since "these etch stop materials are also expected to inherently function as ARC layers". Examiner provides no support for this statement of inherency. Lin et al. only disclose the use of SiN

as an etch stop layer. Nevertheless, the fact that SiON is well known as having antireflectance properties is largely irrelevant to the issue of whether APPELLANTS claimed invention has been suggested or disclosed in Lin et al., Yu et al., or Filipiak et al., alone or in combination, since none of the references alone or in combination, suggest teach or suggest what Applicant has done, or recognize the problem that Applicants have solved, by their disclosed and claimed invention.

"To establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." *In re Oelrich*, 666 F.2d 578, 581-582, 212 USPQ 323, 326 (CCPA 1981).

The prior art as disclosed in Lin et al. is referring to a totally different process of manufacturing dual damascenes. The prior art (e.g., at col 2, lines 34-52,) discloses depositing a **selective etch barrier layer** where SiN or SiON are disclosed to be useful materials **with an appropriate etching selectivity**. The etch barrier is deposited into **a trench opening** followed by etching **an opening through the etch barrier** at the bottom of the trench opening **followed by etching the via hole**. The etch

barrier disclosed in the prior art by Lin et al. is not suggested or disclosed to have or require an anti-reflective property. However, even assuming arguendo, that such a suggestion was present in Lin et al., the teachings of Lin et al., alone or in combination with Yu et al. or Filipiak et al., produce APPELLANTS disclosed and claimed invention nor recognize or solve the problem that APPELLANTS have recognized and solved by their claimed invention:

"A method for reducing light reflectance from via sidewalls in a photolithographic trench patterning dual damascene process"

Moreover, the prior art disclosed in Lin et al. that the Examiner relies on, would not work in the method of APPELLANTS since the purpose of the ARC layer in APPELLANTS disclosed and claimed invention is to reduce light reflections in an overlying trench line patterning process **following formation of a via opening**. Indeed, Lin et al. affirmatively teach away from APPELLANTS claimed invention by requiring either a separate or simultaneous etching step to remove a portion of the protective material **during** etching an overlying trench (col 5, line 62 - col 6, line 14). The principal of operation of Lin et al. is completely different than the principal of operation of APPELLANTS disclosed and claimed invention.

"Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art." *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 1 USPQ2d 1941 (Fed. Cir. 1992).

"If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious." *In re Ratti*, 270 F.2d 810, 123, USPQ 349 (CCPA 1959).

Issue 3

Is the rejection of claim 10 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

APPELLANTS reiterate the statements made above with respect to Issues 1 and 2.

Further, neither Lin et al., Yu et al., nor Filipiak et al., disclose or teach "wherein the at least one via opening includes at least two via openings formed substantially adjacent to one another" in a dual damascene formation process or recognize the problems or suggest a solution for "reducing light reflectance from via sidewalls in a photolithographic trench patterning dual damascene process" with respect to such a structure. The failure of the cited references to recognize the problem with respect to a dual damascene including more than one via opening or suggest a solution to the problem further demonstrates the non-obviousness of APPELLANTS disclosed and claimed invention.

APPELLANTS clearly propose the problem in paragraph 006 of the Specification:

"One problem with the dual damascene process, **especially where metal interconnect lines are in a head to head design** thereby making the distance between metal interconnect lines critical as design rules are scaled down, has been the phenomenon of undercutting the photoresist during a photoresist removal process where portions of a photoresist layer have been unintentionally exposed by scattered or reflected light and are removed after photoresist development. **The term**

"head to head design" is defined as including via openings that are substantially adjacent to one another."

Issue 4

Is the rejection of claims 11, 13, 14, 19, and 22 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

APPELLANTS reiterate the statements made above with respect to Issues 1-3, above.

Further, none of the cited references, alone or in combination, suggests or discloses APPELLANTS disclosed and claimed invention including:

"providing an inter-metal dielectric (IMD) layer comprising a first anti-reflectance coating (ARC) layer over the IMD layer"

Prior to forming via openings, or **substantially conformally depositing a second ARC layer over said IMD layer and the via openings to cover the via opening sidewalls without filling the via openings**, prior to patterning an overlying photoresist layer with trench openings as claimed by APPELLANTS in claim 11.

Further, none of the cited references, alone or in combination, recognizes or suggests a solution to a problems APPELLANTS have recognized and solved"

"reducing photoresist undercutting due to via sidewall light reflections in a dual damascene trench patterning process"

None of the cited references, alone or in combination, teach, suggest or disclose forming a first ARC layer over the IMD layer **prior** to forming **via openings** followed by **forming** a second ARC layer to cover via opening sidewalls **without filling the via openings** as claimed by APPELLANTS in claim 11. Neither do any of the cited references disclose the problem of photoresist undercutting from via sidewall reflections especially in the case where there is more than one via opening, or suggest or provide a solution to the problem as APPELLANTS have done by their disclosed an claimed invention.

Examiner argues that "it would also have been obvious to apply at least one thin conformal ARC layer to the sidewalls of the holes or openings without filling the holes or openings before patterning an overlying resist layer to avoid reflective notching of the photoresist, **as taught by Lin and disclosed by Filipiak**".

APPELLANTS assert that Examiner is clearly mistaken that Lin et al. teach such a process or that Filipiak discloses such a process. Neither Lin et al. nor Filipiak et al. alone or in combination, disclose, hint, or suggest **forming an ARC layer over sidewalls of a via opening without filling the via opening prior to a trench patterning process to reduce light reflection from via sidewalls in the trench patterning process**, a problem recognized and solved by APPELLANTS disclosed and claimed invention.

Rather, Lin et al. teach **filling the via opening** with a **protective material** to protect the via bottom portion in a subsequent trench etching process. Yu et al. teach using a Ti/TiN etching hardmask which also functions as an ARC layer **for etching the via opening (formed prior to forming the via opening)**. Filipiak et al. teach forming a multiple graded ARC

layers over an insulating layer **prior to etching** via openings (see col 5, lines 14-40) and further, **do not disclose a dual damascene process**. The above teachings individually, or in combination, **are clearly insufficient** to make out a *prima facie* case of obviousness, and neither recognize or solve the problem APPELLANTS have recognized and solved by their disclosed and claimed invention.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Issue 5

Is the rejection of claims 15, 17, and 24 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

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APPELLANTS reiterate the statements made above with respect to Issues 1, 2 and 4.

In particular, none of the references, alone or in combination, teach or suggest "depositing a second ARC layer over said IMD layer and the via openings to cover the via opening sidewalls without filling the via openings" **following formation of a via opening**, as claimed by APPELLANTS. In addition, none of the references discloses the materials, or the range of thicknesses for the second ARC layer as Applicants have disclosed and claimed in claims 15, 17, and 24.

Issue 6

Is the rejection of claim 18 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

APPELLANTS reiterate the statements made above with respect to Issues 1, 3 and 4.

Issue 7

Is the rejection of claim 20 under 35 USC § 103(a) as being unpatentable over Lin et al. (US 6,042,999) in view of Yu et al. (US 6,027,861) and further in view of Filipiak et al. (US 5,918,147) proper when such references, alone or in combination, do not teach or suggest APPELLANTS claimed invention or recognize or solve a problem in a way that APPELLANTS have recognized and solved by their claimed invention?

APPELLANTS reiterate the statements made above with respect to Issues 1 and 4.

Further, none of the references cited, alone or in combination, teach forming a first ARC layer over first and second dielectric layers **prior to forming a via opening**, and **forming at least one additional ARC layer substantially conformally to cover via opening sidewalls without filling the via opening following formation of a via opening**, as claimed by APPELLANTS, in claim 20 (second dielectric layer).

None of the cited references, or any combination thereof, suggest or discloses the problem, or a solution thereto, that APPELLANTS have recognized solved by their disclosed and claimed

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invention, thereby demonstrating the non-obviousness of APPELLANTS disclosed and claimed invention.

CONCLUSION

Examiner has not met the burden of establishing a *prima facie* case of obviousness and moreover, APPELLANTS disclosed and claimed invention has been demonstrated to be nonobvious. None of the cited references individually or in combination recognize or solve the problem of light reflections from via opening sidewalls to undercut a resist layer in a trench patterning process, by covering via opening sidewalls with an ARC layer **without filling the via openings**. The fact that Examiner can produce no references disclosing or suggesting APPELLANTS disclosed and claimed invention strongly supports a conclusion of nonobviousness.

"We do not pick and choose among the individual elements of assorted prior art references to recreate the claimed invention, but rather we look for some teaching or suggestion in the references to support their use in a particular claimed combination" *Symbol Technologies, Inc. v. Opticon, Inc.*, 935 F.2d 1569, 19 USPQ2d 1241 (Fed. Cir. 1991).

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It is therefore respectfully submitted that Examiners final rejection of Appellants claims is improper under the statutory standard of 35 USC § 103(a) as interpreted by both the Board and the Courts.

The reversal of the final rejection is respectfully solicited from the Board.

Respectfully submitted,

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CLAIM APPENDIX

1. A method for reducing light reflectance from via sidewalls in a photolithographic trench patterning dual damascene process comprising the steps of:

providing an inter-metal dielectric (IMD) layer comprising at least one via opening extending through a thickness thereof;

forming an antireflectance coating (ARC) layer over the IMD layer such that the ARC layer is formed over sidewalls of the at least one via opening without filling the at least one via opening; and,

depositing a photoresist layer over the IMD layer and photolithographically patterning a trench opening over the at least one via opening.

2. The method according to claim 1, wherein an etching stop layer is provided over said IMD layer.

3. The method of claim 2, wherein the etching stop layer is selected from the group consisting of silicon oxynitride and silicon nitride.

4. - 6. (cancelled)

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7. The method of claim 1, wherein the ARC layer is selected from the group consisting of silicon oxynitride and titanium nitride.

8. The method of claim 1, wherein the ARC layer is formed within a range of thickness from about 100 Angstroms to about 1000 Angstroms.

9. (cancelled)

10. The method of claim 1, wherein the at least one via opening includes at least two via openings formed substantially adjacent to one another.

11. A method of reducing photoresist undercutting due to via sidewall light reflections in a dual damascene trench patterning process comprising the steps of:

providing an inter-metal dielectric (IMD) layer comprising a first anti-reflectance coating (ARC) layer over the IMD layer;

forming via openings extending through a thickness portion of the IMD layer;

substantially conformally depositing a second ARC layer over said IMD layer and the via openings to cover the via opening sidewalls without filling the via openings; and,

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forming a photoresist layer over the IMD layer and photolithographically patterning trench openings disposed at least partially over the via openings.

12. (cancelled)

13. The method of claim 11, wherein an etching stop layer is provided over the IMD layer underlying the first ARC layer.

14. The method of claim 13, wherein the etching stop layer is selected from the group consisting of silicon oxynitride and silicon nitride.

15. The method of claim 11, wherein the second ARC layer is selected from the group consisting of silicon oxynitride and titanium nitride.

16. (cancelled)

17. The method of claim 11, wherein the second ARC layer is formed within a range of thickness from about 100 Angstroms to about 1000 Angstroms.

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18. The method of claim 11, wherein said via openings are formed substantially adjacent to one another.

19. The method of claim 11, further comprising repeating said method as part of a manufacturing process to form a multi-level interconnected semiconductor structure.

20. An improved method of reducing light reflectance from via sidewalls in a dual damascene trench patterning process comprising the steps of:

- forming a first dielectric layer over an underlying substrate;

- forming at least one second dielectric layer over said first dielectric layer;

- forming at least one anti-reflectance coating (ARC) layer over the at least one dielectric layer;

- forming at least one via opening through a thickness of the ARC layer, the at least one second dielectric layer, and the first dielectric layer;

- forming at least one additional ARC layer substantially conformally over the at least one ARC layer and the at least one via opening to cover the at least one via opening without filling the at least one via opening;

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forming a layer of photoresist over the at least one additional ARC layer; and,

photolithographically patterning a trench opening over the at least one via opening.

21. The method of claim 1, wherein the ARC layer is deposited according to a plasma enhanced chemical vapor deposition (PECVD) process.

22. The method of claim 11, wherein at least the second ARC layer is deposited according to a plasma enhanced chemical vapor deposition (PECVD) process.

23. The method of claim 1, wherein the ARC layer consists essentially of silicon oxynitride.

24. The method of claim 11, wherein the first and second ARC layers consist essentially of silicon oxynitride.

25. - 26. (cancelled)